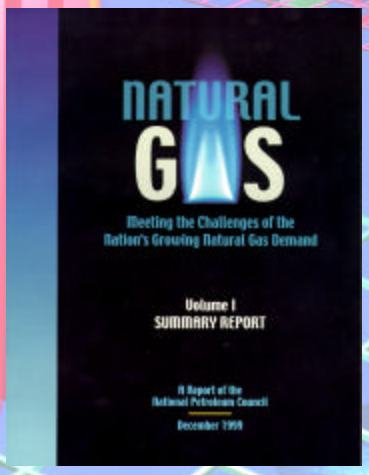
WORKSHOP SUMMARY

U.S. Department of Energy Workshop

Surveying the Milestones for Meeting the Challenges of the Nation's Growing Natural Gas Demand



March 5-6, 2001
Washington, DC

Summary of U.S. Department of Energy Workshop on Surveying the Milestones for *Meeting the Challenges of the Nation's Growing Natural Gas Demand*

A Review of the National Petroleum Council's December 1999 Report

March 5-6, 2001

Washington, DC

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Acknowledgments

In the last decade, as the United States has moved towards ever-increasing reliance on natural gas as the fuel-of-choice for the 21st century, the Department of Energy (DOE) has looked to the National Petroleum Council to provide expert analysis and recommendations on the key issues affecting natural gas.

The National Petroleum Council is a federal advisory committee to the Secretary of Energy whose members include representatives of the oil and gas industry, consumer and environmental groups, the financial community, and states, among others. Its sole purpose is to advise, inform, and make recommendations on any matter requested by the Secretary relating to oil and natural gas or to the oil and natural gas industries.

The Secretary of Energy first asked the Council to analyze the domestic natural gas industry and assess its potential to increase its role in the Nation's energy supply mix in 1990. The Council responded with a comprehensive report in 1992 that served as the foundation for much of the natural gas discussions and policy decisions made since that time. As the Nation's move to natural gas grew even faster than anticipated the Council responded to another Secretarial request with a second comprehensive report on natural gas in 1999. More than 150 individuals participated in developing the 1999 report.

The National Petroleum Council has continued to support the Department of Energy in its efforts to keep up to date on evolving issues in the dynamic North American natural gas market. Specifically, it helped the Department organize a workshop on March 5-6, 2001 in Washington, D.C. to survey the milestones on assumptions, findings, and recommendations set forth in the 1999 Council report. More than 50 individuals, representing a wide array of energy interests including natural gas suppliers and transporters, electric utilities, trade associations and federal agencies, participated in the DOE workshop.

The Department expresses its gratitude to the Council for helping to make the March 5-6, 2001 DOE workshop a success. In addition, the Department would like to acknowledge the substantive work and expert advise of: Edward Gilliard, John Guy, John Hull, Paul Kelly, Marshall Nichols, Tommy Nusz, Blaise Poole, Matthew Simmons, Advanced Resources International (Vello Kuuskraa and Jeffrey Eppink), Energy and Environmental Analysis, Inc. (Harry Vidas and Kevin Petak), and Technology & Management Services, Inc. (Feridun Albayrak). Each of the workshop participants made valuable contributions to the discussions. Department of Energy personnel supporting the conduct of the workshop included: David Costello, Guido DeHoratiis, Nancy Johnson, James Kendell, Robert Kripowicz, John Pyrdol, Trudy Transtrum, and William Trapmann.

Workshop Summary

Introduction

In the last ten years, the U.S. has struggled with the decision of what fuel, or fuels, to rely on to power the Nation's economy as we move into the 21st century. Two of the primary criteria in this decision are that the fuel has to be available in secure, reliable, and reasonably-priced volumes, and that the fuel has to contribute to the goal of protecting the environment. Out of this process, natural gas clearly emerged as the fuel-of-choice for the coming decades.

In 1990, when it first became apparent that natural gas might play a bigger role in meeting the country's needs for a clean and reliable fuel, Secretary of Energy James Watkins asked the National Petroleum Council (NPC) to undertake "...a comprehensive analysis of the potential for natural gas to make a larger contribution, not only to our Nation's energy supply, but also to the President's environmental goal." The Council responded with a 5-volume report in 1992 entitled, *The Potential for Natural Gas in the United States*, which concluded that "natural gas has the potential to make a significantly larger contribution both to this Nation's energy supply and its environmental goals." This was a landmark report that encouraged U.S. industry and government to rely on natural gas to meet the Nation's energy and environmental goals.

The NPC 1999 Report

By 1998, it was apparent that the move towards natural gas envisioned in the 1992 NPC report was occurring even faster than expected due to growing industrial demand, slower-than-expected improvements in end-use efficiencies, and restructuring of the electric utility industry. In response, Secretary of Energy Federico Peña asked the Council to "...reassess its 1992 study taking into account the past five years' experience and evolving market conditions that will affect the potential for natural gas in the United States to 2020 and beyond." The NPC delivered its report, *Meeting the Challenges of the Nation's Growing Natural Gas Demand*, to Secretary Bill Richardson in December 1999.

Today, natural gas supplies almost a quarter of the Nation's energy needs. As projected in the NPC 1999 report, demand is expected to grow by almost a third by 2010, increasing to 29 trillion cubic feet (Tcf) in 2010 and to beyond 31 Tcf by 2015 (Figure 1). Demand will increase in all consumption sectors—residential, commercial, industrial, and electricity generation—with the largest growth in electricity generation as natural gas remains the preferred fuel for new electricity generation facilities (Figure 2) and in all regions of the country (Figure 3). More than 14 million new customers will be connected to natural gas supply by 2015 and many more will find their growing electricity needs met by gas-fired generators.

As described in the 1999 report, the Council found that the domestic natural gas resource base was adequate to meet increasing gas demand for many decades. It also found, however, that realizing the full potential of natural gas use in the United States would require focus and action on seven critical factors including:

- access to resources and rights-of-way,
- continued technological advancements,
- financial requirements for developing new supply and infrastructure,

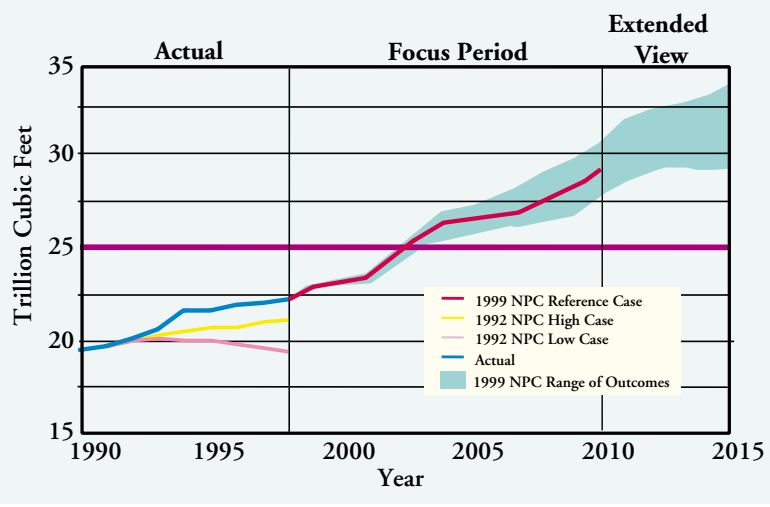


Figure 1. U.S. Natural Gas Demand. Comparison of 1992 and 1999 NPC Reports.

- availability of skilled workers,
- expansion of the U.S. drilling fleet,
- assuring reasonable lead times for development, and
- meeting changing customer needs.

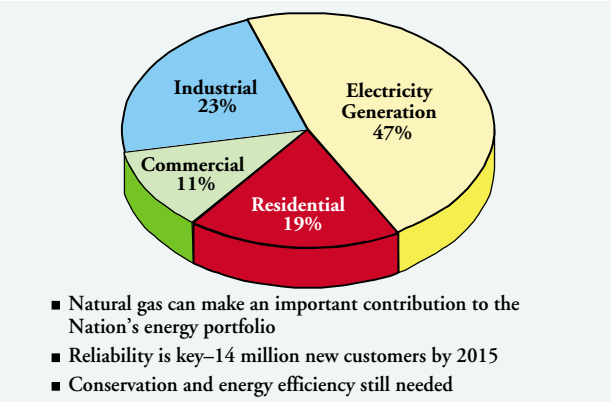


Figure 2. Natural Gas Demand Growth in NPC Reference Case (1998-2010): Distribution of 7 Tcf Increase by Sector.

In response to these concerns, and to ensure that the mutual goals of government, industry and consumers are met, the Council in 1999 recommended that:

- an interagency group be formed at the highest levels of government to create a strategy for natural gas in the Nation's energy portfolio,
- a balanced, long-term approach for responsibly developing the Nation's natural gas resource base be established,
- technology research and development be emphasized,
- a plan for capital, infrastructure, and human resources be created,
- government processes that impact gas development be streamlined to eliminate duplication and conflicting directives,
- the impact of environmental regulation be assessed to objectively weigh the environmental benefits of natural gas consumption versus the environmental impacts of natural gas exploration and production, and
- new services be designed to meet changing customer needs.

The Council also recommended that, recognizing the Nation's changing energy needs and the dynamic nature of natural gas markets, the Department should periodically monitor trends in the assumptions used in the study and progress in meeting the critical factors identified in the report.

DOE'S Workshop on March 5-6, 2001

Since the NPC report was released in December 1999, the domestic natural gas market has experienced considerable volatility with prices for natural gas reaching as high as $10 per million Btu (MMBtu) on the spot market. In 2000, average wellhead prices were about $3.40 per MMBtu ($1998), 70% higher than the typical $2 per MMBtu price seen in the 1990s (Figure 4). Historically high gas storage withdrawals and imports were required to meet gas demand. In view of these recent market events, and concerns raised that demand for natural gas may be increasing at a rate that the natural gas industry may find difficult to supply, it was clear that a review of the report and its assumptions would be useful.

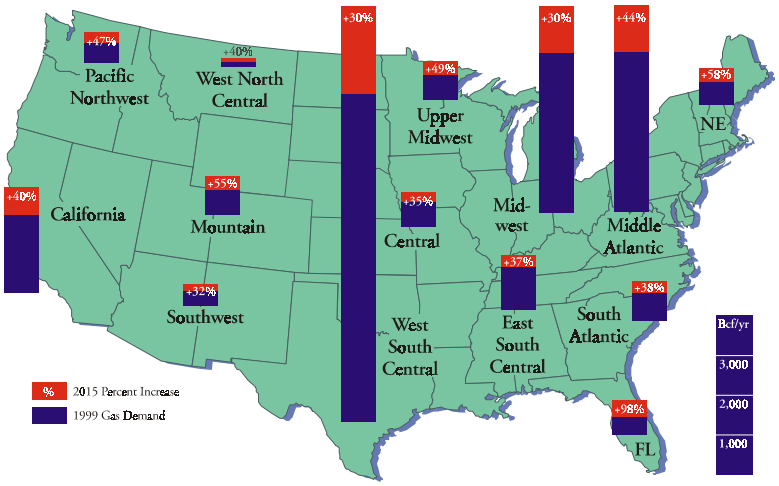


Figure 3. Natural Gas Demand Will Increase In All Regions (1999 NPC Reference Case).

Accordingly, the Department sponsored a workshop on March 5-6, 2001, to provide an opportunity for industry and government executives, especially those individuals who participated in developing the NPC 1999 report, to discuss and share their individual observations on the report and changes that have been seen in the marketplace since the report was released.

A "roadmap" highlighting key assumptions from the NPC 1999 report provided the backdrop for workshop discussions (Figure 5). In three areas that corresponded to Task Groups previously organized by the Council —Demand, Supply, and Transmission and Distribution—the workshop participants reviewed:

- assumptions used in the NPC 1999 report Reference Case or derived from the modeling results,
- changes in natural gas market conditions and public policies since the NPC 1999 report was released,
- the magnitude of these changes (e.g., as compared to results or sensitivity analyses from the NPC 1999 report), and
- possible implications these changes may have for the results, findings and recommendations of the NPC 1999 report.

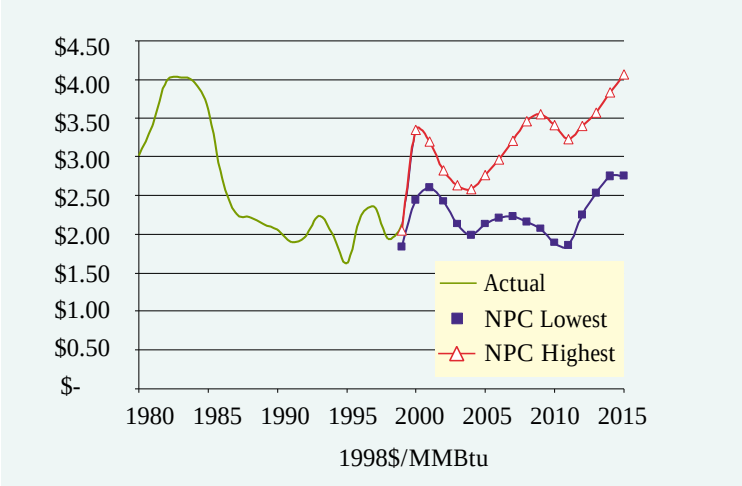
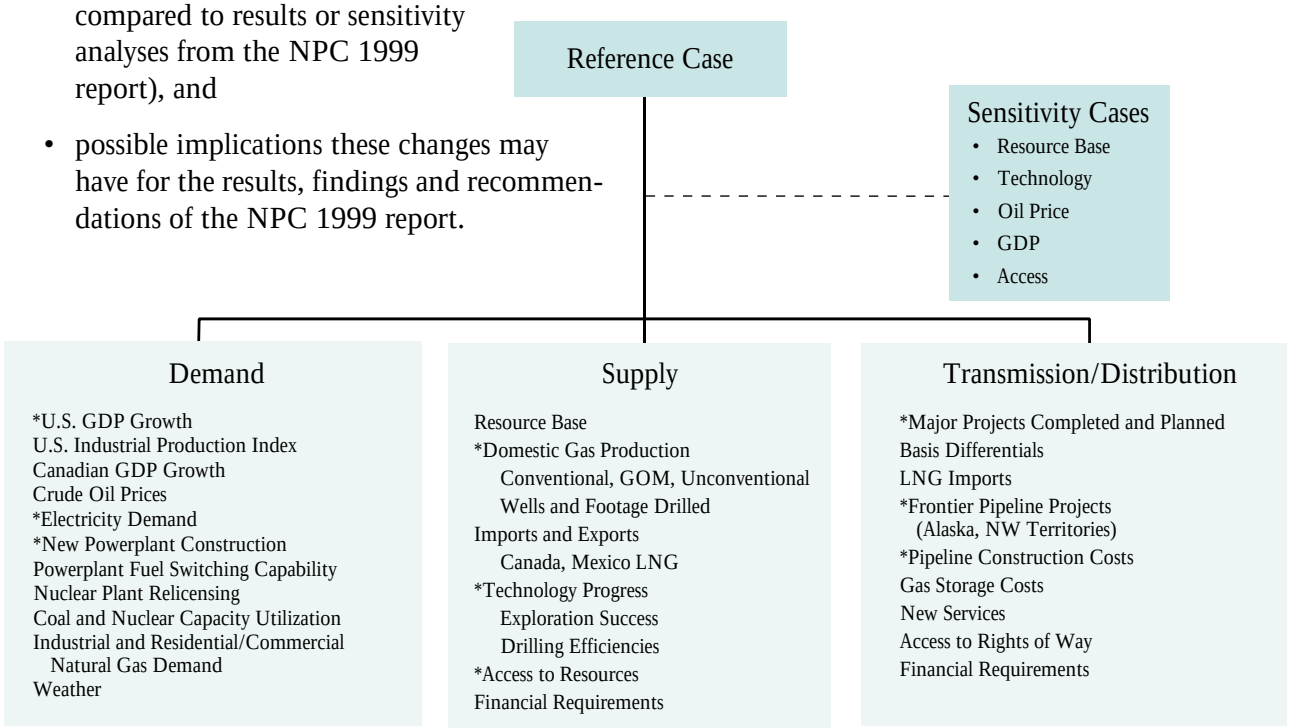


Figure 4. Average U.S. Wellhead Gas Price—1999 NPC Cases.

The Department requested that the workshop participants share their expert insights and observations on the recent events in the natural gas industry, and did not seek a consensus view. The purpose of the workshop was for the participants to gain an improved understanding of our Nation's energy situation and the evolving role of natural gas in meeting the energy needs of consumers.



*Key issues.

Figure 5. NPC Natural Gas Study Roadmap.

Workshop Commentary

Over the past two years, a number of significant changes have taken place in natural gas markets. Demand has increased significantly, driven primarily by power generation needs, while domestic production has not kept pace with demand. The situation reached levels of significant concern this past December when the "perfect storm" hit domestic gas markets. Following a cold November, December was even colder—over 20% colder than normal. Gas storage had already been heavily drawn down and, the supply/demand balance was tight as end-users that could switch to oil had already done so. As a result, in December 2000, wellhead natural gas prices nationwide averaged $5.55 per MMBtu, almost three times the prices one year earlier, and peaked at over $10.00 per MMBtu.

The increased demand over recent months has been made up mostly by one-time increased drawdown from storage, as well as increased imports from Canada and decreases in demand (fuel switching and reduced consumption in the industrial sector). The extent to which these trends can continue is unclear. It appears that demand will continue to grow as least as quickly as envisioned in the 1999 NPC report, and possibly faster. As a Nation, we need to examine closely how the marketplace will accommodate this increased demand for natural gas.

With respect to oil prices, the NPC Reference Case oil price assumption was $18.50/bbl West Texas Intermediate (WTI) in real 1999 dollars and $16.50 for refiners average cost of crude (RACC). These prices were chosen for the study because they are the actual long-run average over several decades. (High Oil Price and Low Oil Price sensitivity cases assuming long-run WTI oil prices of plus or minus $3.50/bbl were also run.) Actual oil prices (Figure 6) in 1999 and 2000 were higher than even the High Oil Price case. The high oil prices stimulated drilling activity and led indirectly to higher gas prices through much of 2000 when gas competed with distillate and fuel oil at the burner tip.

There was discussion among the participants that if oil prices stayed high, upward pressure would be placed on gas prices because in the NPC Reference Case and in most of the sensitivities, potential gas demand was projected to be switched to oil to balance the market. If oil prices were higher, then gas prices would also be higher than projected. While these higher prices would bring in more gas supply, they might also inhibit long-term gas demand by, for example, making coal more economic for new power plants.

The participants discussed the fact that about 12,000 megawatt (MW) of new coal capacity beyond that projected in the NPC study has already been announced in the last six months due to high gas and oil prices. There was some disagreement as to whether these and other new coal plants that might be planned in the future would add to the NPC projection for coal generation or make up for old coal plants that will be retired due to the high cost of retrofitting environmental controls.

As might be expected, workshop participants presented a range of views, from expectations that the marketplace would shortly come back into balance, albeit at higher price levels than in the past, to more ominous views that acute natural gas shortages may be in the offing in the near future. What became clear, however, was that there may be inadequate data at this time with which to decide among differing views regarding the implications of nascent trends.

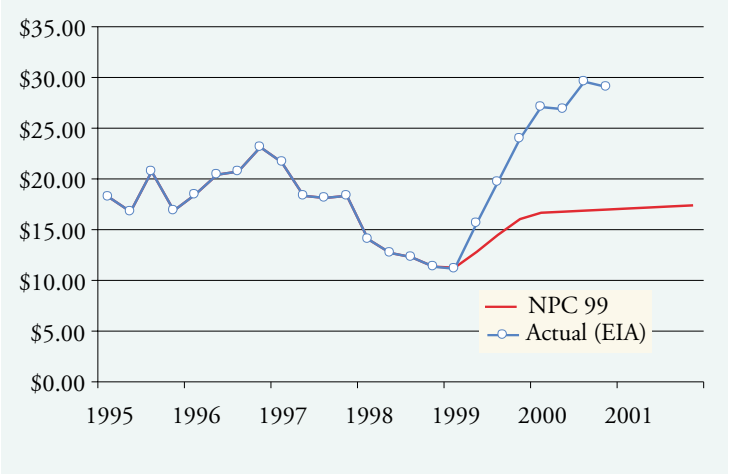


Figure 6. Oil Price (RACC) (Nominal U.S. Dollars per Barrel).

Participants universally saw the need for increased benchmarking of key demand, supply, and transmission and distribution milestones, which would help clarify the situation. Further, there was a call to reconvene another workshop in six to nine months when improved data on year 2000 and information on trends for 2001 would be available and more meaningful directions could be established.

The NPC 1999 report has been characterized as the most definitive body of information outlining industry's ability to meet future demand for natural gas in the United States. And, overwhelmingly, workshop participants reaffirmed the value of the NPC 1999 report and the validity of the recommendations therein. While the growth in natural gas demand projected in the report may turn out to be conservative if demand increases more rapidly than anticipated, the common theme expressed by workshop participants was that the results, findings and recommendations of the NPC 1999 report are even more critical today and that, as a long-range document, it remains valid. It was stated repeatedly that an even greater sense of urgency should be attached to its findings and recommendations, particularly for decision makers in government and industry.

The balance of this workshop summary presents the key issues and trends identified and discussed by workshop participants on natural gas demand, supply, and transportation and distribution. The report also examines the status of the critical factors set forth in the NPC 1999 report and highlights new issues that have emerged since the issuance of the report. Material from presentations made at the workshop can be found in the Appendix. For the sake of brevity, NPC 1999 report assumptions that were not considered by workshop participants to warrant critical benchmarking are not described.

Natural Gas Demand

The estimated actual gas demand in year 2000 was about 0.5 Tcf higher than expected by the NPC 1999 report reference case (Figure 7).[1] Workshop participants discussed how harsher weather in 2000, together with less electric production from hydro units, had contributed to the strong demand for natural gas. The participants also noted that unusually high net withdrawals from gas storage, both in the U.S. and Canada, helped meet the demand for natural gas when gas supplies were lower than expected in 2000.[2]

As foreseen by workshop participants, higher growth in the Gross National Product (GDP), greater installation of gas-fired power generation capacity, emerging environmental concerns, and government policies that encourage gas use, could all contribute to future gas demand growing even faster than set forth in the NPC 1999 report. Close monitoring and benchmarking of this issue was determined by the workshop participants be a high priority, particularly to provide reliable information to industry.

Given short-term GDP growth of 4.2% in 1999 and 5% in 2000, versus the long-term 2.5% annual growth

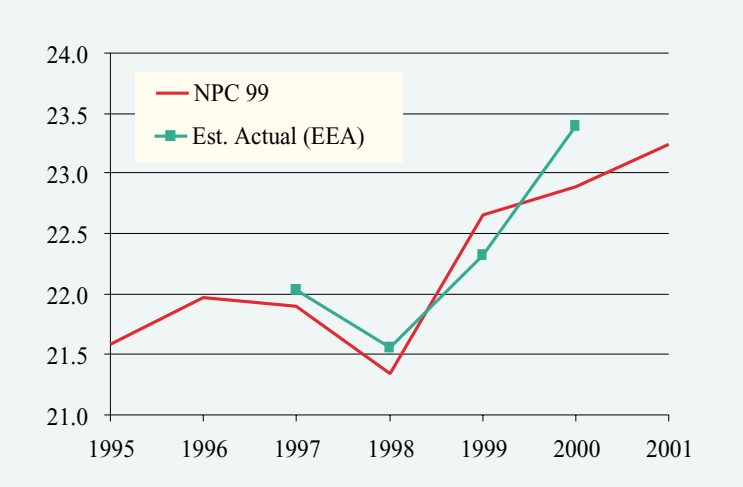


Figure 7. U.S. Total Gas Consumption (Tcf/year).

[1] Estimated actual demand for 1999 and 2000 were calculated by adjusting EIA's consumption data (source: EIA's *Natural Gas Annual and Natural Gas Monthly*) by their "balancing items" to less gas production and greater gas consumption for those years.

[2] While the NPC projection foresaw that the drilling declines in 1999 would lead to a very tight gas market in 2000, it had assumed that fuel switching to oil (rather than storage withdrawals) would balance the market. High prices for oil in 2000 prevented the fuel switching from occurring as anticipated.

assumed in the NPC 1999 report Reference Case (Figure 8), workshop participants stated that consideration should be given to using higher GDP growth rates of about 3% in future analyses of natural gas demand. It was noted that the EIA had increased expected GDP growth rates to 3% annually in recent analyses. (The NPC analysis also included a 3% GDP growth sensitivity case.) Participants observed that, if actual average GDP growth rates continue to be higher than the 2.5% average GDP growth rate used in the NPC Reference Case, the gap between actual natural gas demand and the Reference Case demand could widen significantly as time progresses.

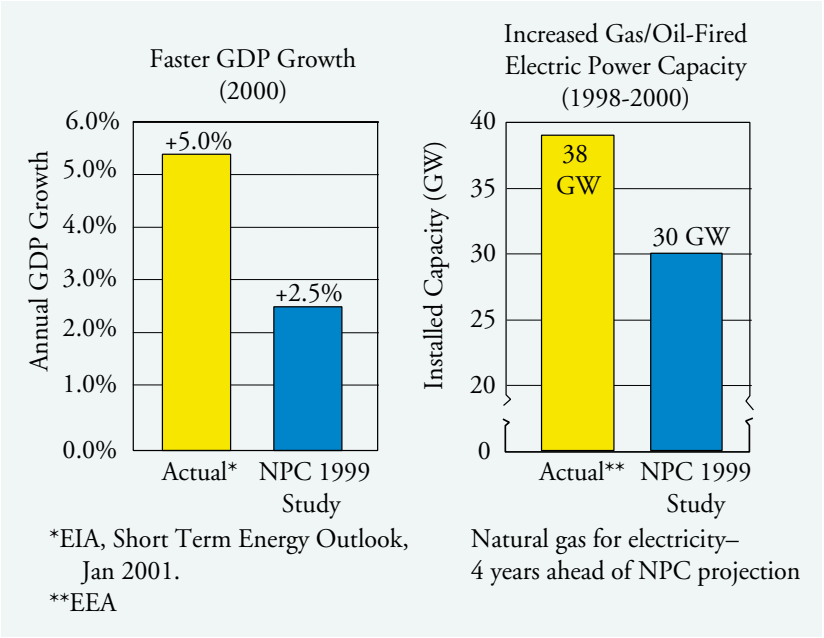


Figure 8. GDP Growth (2000) and Gas/Oil-Fired Electric Power Capacity (1998-2000).

Workshop participants acknowledged that more gas-fired power capacity had been installed in the past two years and that much more would be installed in the next several years than expected in the NPC 1999 report. Participants noted that the availability of data on the role and use of these plants, ranging from peaking to near base load, would be useful to better define new demand for natural gas from power generation.

Much workshop discussion centered on the need for improved data on national as well as regional electricity demand and capacity. Improved data on new gas-fired generating capacity was viewed as particularly important, as companies look to rebuild spare capacity in selected regions of the country, such as California and New England. It was noted that reduced electricity generation from hydropower had exacerbated the California power crisis, although increased utilization of nuclear plants had compensated for shortages in hydropower nationwide.

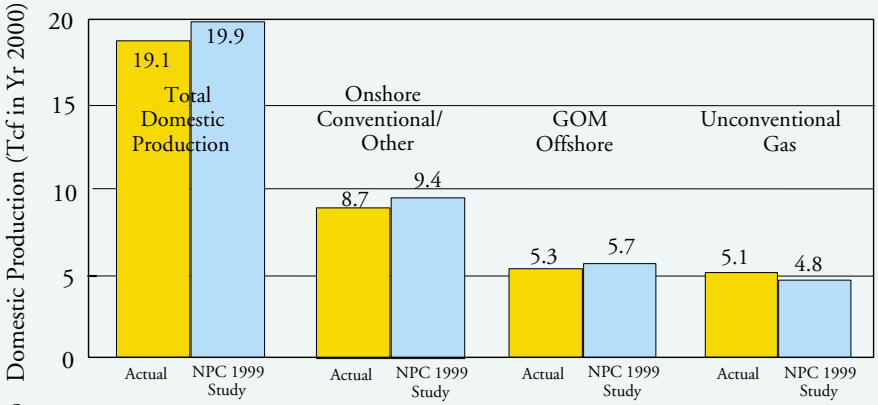
Considerable workshop discussion centered on establishing how much fuel switching actually took place last year when natural gas prices (on a Btu basis) exceeded distillate oil prices. Also, there were requests for improved data on the physical (and regulatory) ability to switch from gas to distillate and more reliable information on the fuel choices available to the Nation's industrial sector and how much reduction in industrial gas demand occurred this past winter as aluminum and ammonia plants shut down their manufacturing capacity and sold gas back into the marketplace.

Workshop participants expected that actions that may be taken to address concerns over the role of carbon dioxide (CO_2) and greenhouse gas emissions as well as controls on other coal-fired power plant emissions would likely increase the demand for natural gas. Placing CO_2 capture equipment in plants would significantly reduce (by 20 to 25%) the generating capacity of current coal-fired power plants.

Natural Gas Supply

Workshop participants recognized that supply is determined fundamentally by the quality of the resource base and the availability of appropriate technology by which to produce it. In the U.S., the natural gas resource base is large. But, at the same time, participants emphasized that the remaining domestic natural gas resource base is geologically complex and consists of smaller fields. The geologic quality of remaining resources is likely becoming poorer, or as described in the words of one participant, mimicking the popular political slogan, "It's the geology, stupid." One

participant observed that his company has drilled prospects down to about 4 Bcf and what is left is smaller, tighter and costly to drill. He also noted that reserves growth is not as great for new fields as was the case in the past, suggesting that reserve growth factors should be monitored. It was stated that frontier areas such as the Arctic and deepwater offshore provide opportunities for improved exploration success and expanding the resource base, but that many of these frontier areas are on public lands and have access constraints. To address these issues, workshop participants suggested that trends in exploration and production (E&P) should be monitored to discern if reserve additions per well and field sizes are truly declining faster than anticipated, implying the need for more drilling and higher costs than anticipated in the NPC 1999 report.



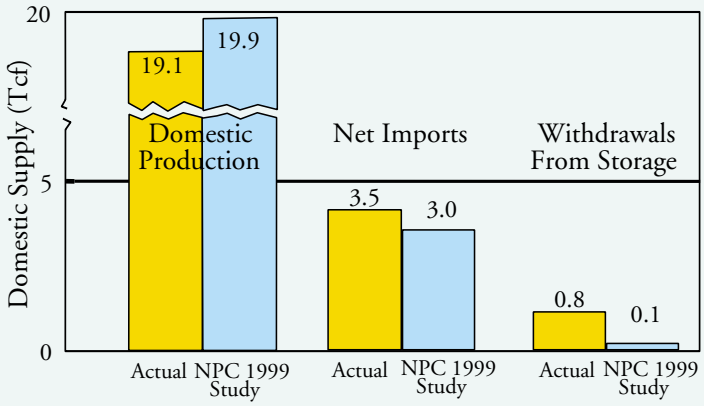
Source:
Total – EIA Monthly Energy Review, Jan 2001 (0.4 Tcf of Difference Due to Calibration Differences, NPC vs EIA).
Offshore – ARI estimates.
Unconventional – ARI estimates

Figure 9. Domestic Natural Gas Production for 2000 Was Below Expectations, Except Unconventional Gas.

In 2000, actual natural gas production in the U.S. relative to the NPC 1999 report Reference Case was lower than projected (Figure 9). Greater natural gas imports and withdrawals from storage were used to meet demand (Figure 10). Workshop participants indicated that prompt analysis of the reasons behind the (thus far) lower-than-expected supply response was essential for understanding the outlook for future natural gas supply.

Although domestic production for 2000 appeared to be less than anticipated in the NPC 1999 report, whether this is due to low prices in previous years inhibiting investment in new drilling, to time lags, or to poorer exploration success rates and drilling efficiencies is not yet clear. Several workshop participants expressed the view that sufficient time had passed for seeing a production response given the speed with which wells are hooked up to the pipeline system in the present market.

In contrast, progress in E&P technology appears to be lagging (Figure 11). The NPC 1999 report Reference Case assumed a 1.5% annual improvement in exploration success, while recent actual success rates appear to have declined. Similarly, drilling efficiency (footage drilled per rig per year) was assumed to improve 1.25% annually for operations onshore and in the shallow Gulf of Mexico (GOM) and 1.5% in the deepwater GOM. While drilling efficiency improved through 1998, recent data appear to show a decline. The group felt strongly that these issues need to be closely monitored, recognizing that more data is needed before it can be determined if these are short-term events or long-term changes in these factors. Ac-



Source: Energy Information Administration

Figure 10. Actual vs. Expected Sources of Natural Gas Supply 2000.

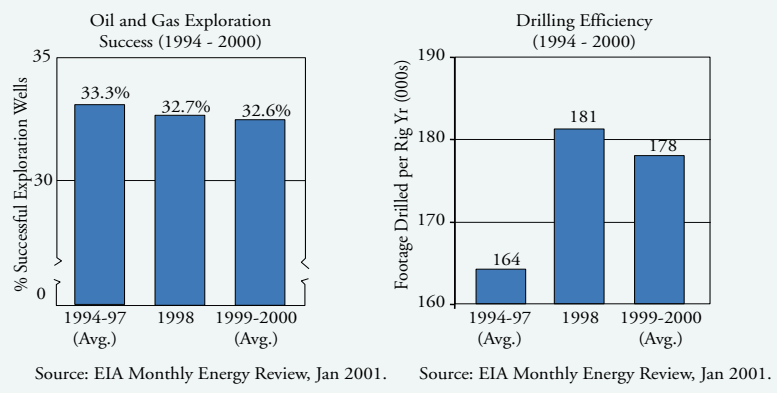


Figure 11. Progress in E&P Technology.

celerating depletion rates were cited as one cause for overall flat or falling production and that depletion rates should also be monitored. As demand for natural gas increases, due to smaller field sizes and more rapid depletion, some perceive that industry may be "running in place" to maintain production despite doing all it can to increase the pace of drilling activity.

The group noted that near-term supply response will depend upon production from coalbed methane (CBM) and the deepwater GOM, which are being produced at rates higher than or equal to these projected in 2000.

Longer term, U.S. production will depend on having adequate technology to efficiently develop coalbed methane, deep gas, tight sands and other unconventional gas plays. Independents will continue to play the critical role in developing these new natural gas plays and will be users of newly developed technology. Observations were made that there have been very few "step change" improvements in exploration and production technology over the last decade, most notably being the wider application of 3-D seismic and horizontal drilling.

To meet future natural gas demand, the NPC 1999 report Reference Case projected that 14% of supply would come from the Rocky Mountains and 33% from the Gulf of Mexico. It was commented that when the Deepwater Royalty Relief Act, which has been cited by the Minerals Management Service (MMS) and industry as providing a stimulus to deepwater development, expired in December 2000, an opportunity was missed to continue the program and provide strong incentives for increased deep water production. It was noted, however, that the MMS extended deepwater royalty relief in a reduced form and also provided incentives for natural gas development on the shelf.[3]

Given the delayed domestic production response to drilling, much of the spare supply capacity to meet demand growth was consumed the past year. Canada has been exporting natural gas to the U.S. significantly in excess of NPC 1999 report projections. It was indicated by workshop participants that it is unclear whether Canadian production can uphold this trend. The Maritimes and Northeast pipeline, which came onstream a year earlier than projected at a rate of 440 million cubic feet per day, accounts for a portion of the increase in Canadian imports. Additional gas imports came from drawdown of Canada's gas storage. Participants indicated that further information would be valuable to more fully understand the nature of the gas supply from Canada. One encouraging note was that drilling in Canada is moving further toward frontier areas, northern basins, and deeper formations in established basins.

Participants also noted that pipelines from both Alaska and the MacKenzie Delta may be needed to meet future natural gas demand. Even though natural gas from these areas may not be available to the Lower-48 states until the 2008 to 2010 timeframe, action needs to be taken to preclude further delay. While pipelines from these areas may face economic competition with increased imports of LNG, it was stated that, most likely, both sources of gas supply would be needed.

Expanded supply is also expected to occur from the increased use of existing LNG facilities and the con-

[3] From the perspective of the Department of the Interior, a March 2001 Central Gulf of Mexico lease sale conducted with these terms was extremely successful yielding $505 million in high bids on 54 tracts (68% and 60% increases respectively, over the previous year's result, with increases evident at all water depths). Ninety companies participated, including 11 first time bidders.

struction of new LNG facilities. New LNG facilities will need to make a positive case to the public on value and safety and will depend upon long-term price and supply in world markets.

Participants noted that exports of about 50 Bcf per year from the U.S. to Mexico may increase given projected growth in Mexican demand for natural gas, especially in border states due to the growing presence of NAFTA-related "maquilladora" manufacturing facilities in Mexico. Environmental compliance involving converting residual oil-fired power plants to natural gas and the manufacturing and population growth in the near-border areas would maintain increasing demand. A number of workshop participants predicted that, even with expanded natural gas development in Mexico's gas basins, Mexico would continue to call on U.S. natural gas supplies.

Finally, volumes of gas in storage at the end of this winter season are likely to be historically low. With the trend towards year-around gas demand for electricity, storage injections are likely to be low during the coming summer, raising concerns as to whether adequate injections can be made in preparation for the next winter season. It was also noted that demand to warrant new and extended storage capacity, while needed by power generators, is "just not yet there."

Transmission and Distribution

The NPC 1999 report assumed that over 5.2 Bcf per day of new pipeline capacity would be built in 1999 and 2000. Actual additions were 7.7 Bcf per day, exceeding expectations. Participants noted that, while this may be good news, future capacity installations face substantial challenges due to constraints on access to rights-of-way, landowner concerns and other factors. Through 2015, in the NPC 1999 report, it was projected that almost 300,000 miles on new transmission pipelines and distribution mainlines would be needed to meet the future natural gas demand. Despite recent gains in pipeline capacity, the need for a significantly expanded natural gas infrastructure remains. Future needs include new pipelines to reach supplies in frontier regions, expansion of existing pipeline systems, and new laterals to serve electricity plants.

While recognizing the continued need for responsible development by industry, new safety regulations were noted as a major concern for the industry by workshop participants. It is anticipated that these regulations may increase capital and operations and maintenance costs, may restrict gas flows, and increase costs to consumers. Additional inspections, valve replacements, making old lines "smart-piggable" and other requirements could add billions of dollars of increased costs. Lost capacity could also result, especially in the critical summertime period, as lines are undergoing inspection and upgrading.

Reliability of supply to end-users was also a concern. And, this issue is currently being reviewed by the Federal Energy Regulatory Commission. Such reliability concerns have to do with serving new power plants that will come online, but which operate only during certain periods of the day, creating new requirements on interstate gas transmission.

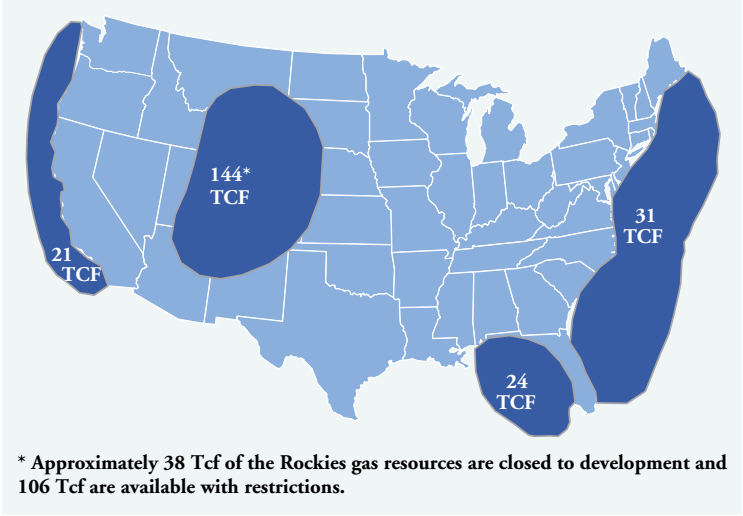
Pipeline costs have increased faster than expected, particularly for rights-of-way. In addition, demand pull has bid up contractor costs. It was noted that, although considerable pipeline capacity has been added in the past two years, future pipeline projects face increasing lead times, especially as a more dominant local role in the rights-of-way approval process emerges, leading one participant to comment that "All access is local."

Critical Factors

The participants in the workshop reviewed the status of the seven critical factors that were identified in the NPC 1999 report. Participants stated that the critical factors remain valid and warrant action and close monitoring more than ever. Several workshop participants characterized the situation regarding some critical factors as having lost ground in recent months, rather than making progress towards a more positive outcome.

1. Access. Of the critical factors identified in the original NPC 1999 report, access received the greatest attention from workshop participants. In the Rocky Mountains, pending implementation of the recently established Department of Agriculture, U.S.

Forest Service policy on roadless areas will close an estimated 9 Tcf of technically recoverable natural gas resources to development in addition to the previous 29 Tcf that were identified as off-limits in the NPC 1999 report. With the roadless areas, resources subject to access restrictions in the Rocky Mountain region will now total 144 Tcf (an increase of 7 Tcf) (Figure 12).



*** Approximately 38 Tcf of the Rockies gas resources are closed to development and 106 Tcf are available with restrictions.**

Figure 12. U.S. Lower-48 Natural Gas Resources Subject to Access Restrictions (NPC 1999 Study Plus Changes Through 2000).

It was noted that the industry has advanced technology such as "postage stamp" drillpads with which to drill in environmentally sensitive areas, but the view was expressed that this may not be enough to convince the public and policymakers to grant access. Rather, it may take stark supply consequences to convince the public that access is in the Nation's interest.

Workshop participants suggested that the current Department of Interior (DOI) and Department of Energy efforts to inventory resources and related access restrictions (called for by the Energy Policy and Conservation Act) would be accelerated. Further comments, however, indicated concerns that DOI and DOE have inadequate funds and other resources to undertake a full and thorough inventory. In some instances, lease stipulations restricting access to federal lands have substantially reduced the drilling window and resulted in reduced rig availability and higher drilling costs.

Concerns were raised about the future of Destin Dome offshore Florida, development offshore California, and Lease Sale 181 in the eastern Gulf of Mexico (which was estimated in the 1999 NPC report to contain about 9 Tcf of resources) and could become closed to access. Concerns were also raised about whether federal land management agencies (e.g., Bureau of Land Management, Minerals Management Service, Forest Service) with jurisdiction over natural gas leasing, development, and permitting have adequate resources for increased, as well as existing, activity.

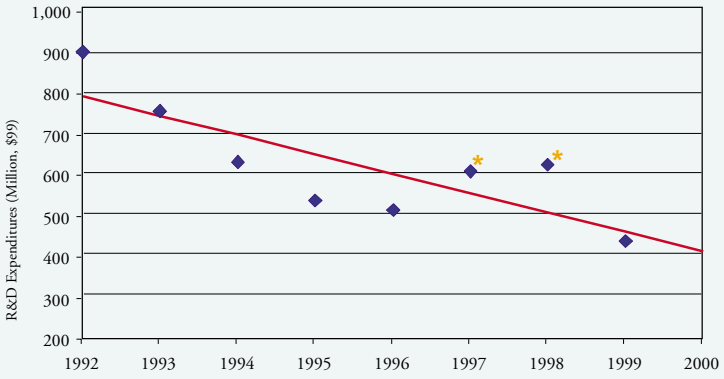
It was stated that, given the success of Canada's Sable Island developments, it would be useful to further assess the Atlantic Outer Continental Shelf (OCS) to provide better information regarding the resource potential in that area.[4] This recommendation was consistent with a prevailing workshop theme suggesting the need to match access to the resource base and regional supply with regional energy needs. ("Regional Supply for Regional Demand").

2. Technology. It was recognized by workshop participants that, although the data are preliminary, progress in technology does not appear to be keeping pace with expectations set forth in the NPC 1999 report. At the same time, workshop participants expressed concern that technology is now more critical than ever. One participant noted that, over the last 15 years, the industry has been able to hold production constant, even with fewer rigs and wells due to the aggressive use of technology. Other workshop participants noted that few, if any, breakthrough technologies appear to be on the immediate horizon.

Research and development (R&D) expenditures by major energy production companies have declined (Figure 13). Although some R&D efforts have been picked up by service companies and independents, data are not available to capture these R&D expenditures. In addition, the comment was made that, although R&D has shifted to the service sector, the research "cupboards are bare" for new technology.

[4] The concept of enabling DOI to gather information on the natural gas resource potential and conduct focused, limited leasing in "OCS Bright Spots" currently constrained by OCS moratoria has been discussed within the DOE OCS Policy Committee and other forums.

Given the severity of market imperfections for R&D, suggestions were made for new institutions and initiatives such as entities similar to those established in the late 1970s and early 1980s, namely the Energy Research and Development Administration (that formed the foundation of today's DOE R&D program in natural gas), and that tax incentives, such as the Section 29 Tax Credit, be implemented.



Source: EIA Performance Profiles of Major Energy Producers, 1999.
*Due to more activity, additional companies added to survey of Major Energy Producers.

Figure 13. R&D Expenditures by Producers for Oil and Gas Recovery Have Fallen by More Than 50% Since 1992.

3. Financial Requirements. Workshop participants noted that the recent higher natural gas wellhead prices have increased companies' internal cash flows and access to capital, although constraints remain, particularly for independents. It was noted that the alternative minimum tax was becoming a forefront issue, impacting the return on investment for new projects. There was concern stated that increases in E&P costs (particularly in well drilling and completion) may consume much of the increases in planned capital expenditures, restricting increased activity. Costs increases of 25 to 40% have been experienced already as labor and rig mobilization costs have increased.

4. Skilled Workers. Workshop participants noted that the past "boom and bust" cycles have damaged the stability of the production industry's work force. The availability of skilled rig hands and other E&P personnel now represents a serious constraint to increasing supply. Some workshop participants indicated that skilled workers (along with rig limitations) are now the most limiting factors for the industry. It was suggested that the solution will of necessity be a combined industry effort comprising such items as training programs, higher compensation, and assurances of stability. In the near term, labor shortages have resulted in companies in several states employing prisoners on work-release and foreign workers.

5. Rigs. Both onshore and offshore rig fleets are near capacity and rig constraints have emerged at least five years sooner than expected in the NPC 1999 report. Time lags of 4 to 6 months exist for securing rigs in South Texas. It was also suggested that new data on drilling costs be collected to benchmark these costs to cost expectations in the NPC 1999 report. Given the even greater-than-expected increase in demand for rigs (nearly 2200 by 2010 in the NPC 1999 report Reference Case), workshop participants cited the need for ideas on how to provide reliable market signals or contractual assurance to the rig construction industry. Given the natural gas price volatility of recent years, neither Wall Street nor the rig construction industry have confidence that prices and rig dayrates will remain high enough to justify investments in new rig construction.

6. Lead Times. Cumbersome permitting and approval processes, and lengthy study requirements at federal, state and local levels, remain a concern. Numerous workshop participants noted that problems with lease stipulations and access are increasing drilling costs and development lead times. One participant noted that the Minerals Management Service has done a good job in terms of expediting permitting for offshore drilling, but, onshore drilling is subject to delays, in part due to lack of sufficient Bureau of Land Management staff.

7. Requirements of New Customers. Workshop participants indicated that new customer requirements can be met, but that a primary issue is at what cost and how these costs will be recovered.

NPC 1999 Recommendations

Workshop participants overwhelmingly reaffirmed the importance of the recommendations put forth by the Council in its 1999 report. Particular emphasis was placed on:

- government and industry taking a leadership role in establishing a strategy for natural gas in the Nation's energy portfolio (Recommendation 1)-as reflected in commentary on national energy policy, future fuel choices, and the confluence of factors including limited spare capacity in domestic and world energy markets that, if not addressed by government and industry, could increase the Nation's vulnerability to energy supply disruptions and higher energy prices that would adversely affect consumers and the economy;
- establishing a balanced, long term approach to responsibly developing the Nation's natural gas resource base (Recommendation 2)-as reflected in commentary on the importance of access to resources and rights-of-way, onshore and offshore;
- the need for technology advancement (Recommendation 3)-as reflected in commentary on drilling efficiency and the geologic complexity of the remaining natural gas resource base;
- the need for capital, infrastructure and human resources (Recommendation 4)-as reflected in commentary on increasing costs to produce and deliver natural gas to consumers, cash flow, investment markets, and shortages of skilled workers and drilling rigs; and
- streamlining government processes that impact natural gas development (Recommendation 5)-as reflected in concerns about development lead times and the adequacy of staff and other resources at federal land management agencies.

New Issues for Consideration

Public Education/Relations. A common theme expressed by many workshop participants was the need for educating the public regarding the challenges faced by industry in providing adequate and affordable supplies of natural gas to meeting the Nation's growing demand for natural gas. Currently the strong interest by the public in energy presents an opportunity for telling the "natural gas story."

The need for communication was expressed, for example, concerning the issue of access, where consumers may be unaware that restrictions on access drive up natural gas prices by limiting supply and discouraging transmission and distribution construction. Similarly, the public may not fully understand what efforts are necessary to turn a complex resource base into economically recoverable reserves and deliver natural gas to the Nation's homes, offices, and factories. Some workshop participants felt perspectives that individual resource areas such as the Atlantic or Pacific OCS may contain only a few year's supply of natural gas, and therefore should remain closed to access, are misguided. And, some suggested that more information needs to be shared with the public about the environmental benefits of the advanced technology. Effective communication between industry and parties that may be affected by its operations is a necessity.

Benchmarking. Workshop participants expressed satisfaction with the outcomes of the workshop and strongly recommended that, consistent with recommendations in the NPC 1999 report, government should undertake efforts in cooperation with industry to periodically "benchmark" actual market conditions relative to the expectations set forth in the NPC 1999 report. Specific items to benchmark include fuel switching, actual gas demand, field size distribution, production, especially Gulf of Mexico shallow water production, depletion, exploration success rates, reserve additions per well, drilling efficiencies, drilling costs, Canadian supply mix, and T&D costs, among others. It was suggested that another workshop would ideally be convened in the Fall 2001, when improved data on year 2000 and information on trends for the year 2001 would be available.

Conclusions of the Workshop

Due to a confluence of factors, the Nation now faces potential constraints in oil, natural gas, and electricity supply, all of which are needed for a growing economy. The situation is such that there is limited spare capacity and, as noted by some participants, "everything must go right" to meet current and future energy demand. Without prompt action by government and industry, America could face a spate of regional and national energy crises over the next decade. As summarized at the workshop, the solutions to the Nation's energy problems are complex and there is no "silver bullet." The Nation will need a mix of fuels, fossil and renewable, coupled with conservation to meet its future energy needs.

The aspiration among participants to stay informed, and to work to inform others, about the opportunities and challenges of natural gas supply was readily apparent. In the view of many workshop participants, the Nation has not had an adequate energy policy, particularly with respect to natural gas supplies in recent years. Furthermore, misunderstandings about the national energy supply situation and crises such as those experienced this winter tend to increase distrust of industry and the likelihood of what some participants perceive to be ill-conceived public policies, e.g., moratoria and price controls. Given current policies that constrain access to higher quality resource areas and other factors, industry will remain significantly challenged to increase supply.

Public debate is turning to a new focus of fueling the economy of the future. In this regard, a significant opportunity exists to highlight issues of concern such as access, technology progress, the need for expedited permitting, and a national strategy for natural gas as a component of the Nation's energy portfolio.

As highlighted in the Council's 1999 report, increased government and industry cooperation is needed to ensure adequate and affordable supplies of natural gas for American consumers. Similarly, natural gas is predominantly a North American resource, and a cooperative North American energy policy is needed to meet demand growth and accelerate supply development in Canada, Mexico, and the U.S.

Highlights of Workshop Commentary

Potential Actions for Government

- Improve interagency coordination
- Establish a national strategy for natural gas
- Review existing and proposed regulations and policies that may impact natural gas supply
- Increase access to resources and right-of-way (Federal lands inventory, Sale 181, Destin Dome, OCS Bright Spots)
- Streamline permitting and approval processes
- Consult with states (maintaining a national perspective)
- Maintain view of North American gas market and international sources of supply
- Encourage technology development
- Evaluate royalty relief and other financial incentives
- Monitor progress on Critical Factors